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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte MATTHEW A. GRANT

Appeal 2013-007497
Application 13/420,710
Technology Center 2800

Before RICHARD TORCZON, JOHN G. NEW, and HUNG H. BUI,
Administrative Patent Judges.

BUI, *Administrative Patent Judge.*

DECISION ON APPEAL

Appellant¹ seeks our review under 35 U.S.C. § 134(a) of the Examiner's final rejection of claims 29-49.² We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.³

¹ The real party of interest is Active-Semi, Inc., (BVI).

² Claims 1-28 have been cancelled and are not on appeal.

³ Our decision refers to Appellant's Appeal Brief filed January 15, 2013 ("App. Br."); Reply Brief filed May 15, 2013 ("Reply Br."); Examiner's Answer mailed March 15, 2013 ("Ans."); Final Office Action mailed October 15, 2012 ("Final Rej."); and the original Specification filed March 15, 2012 ("Spec").

STATEMENT OF THE CASE

Appellant's Invention

According to Appellant, conventional switching regulators regulate power by sensing a current flowing through an external resistor connected in series with a load. *See Spec.*, ¶ [0003]. However, regulating output current, via the external resistor, has several disadvantages, including: (1) large size of the resistor occupying valuable space on a printed circuit board; (2) high cost of a precision resistor that can remain constant over varying temperature; and (3) inefficiency in terms of power loss. *Id.*, at ¶ [0005]. Because of these disadvantages, Appellant's invention seeks to provide a step-down switching regulator (power converter) with an inductor and a converter integrated circuit (IC) using pulse width modulation (PWM) so as to regulate power (output current and voltage) and supply regulated power to a load, i.e., to charge a battery or to power a light emitting diode (LED), without using a current sense resistor that is external to the converter IC. *See Spec.*, ¶ [0007]; FIG. 3 and Abstract.

Claims on Appeal

Claims 29, 34, 37, 38, 39, 45, and 46 are the independent claims on appeal. Claim 29 is illustrative of Appellant's invention, and is reproduced below with disputed limitations emphasized:

1. A method comprising:
generating a reference current, wherein a switching regulator includes an inductor, a power switch and a bootstrap capacitor, wherein the power switch has a source, a drain and a gate and is integrated into an integrated circuit, and

wherein an inductor current flows through the inductor during an on time of the power switch;

generating a sense current whose magnitude is proportional to the inductor current flowing through the power switch during the on time, wherein the sense current is generated ***without sensing a current external to the integrated circuit***, and wherein during the on time the bootstrap capacitor supplies a voltage to the gate of the power switch;

maintaining an output voltage of the switching regulator at a predetermined voltage level when an output current of the switching regulator is less than a predetermined current level; and

maintaining the output current [of the switching regulator] at the predetermined current level when the output voltage is less than the predetermined voltage level, wherein the output current reaches the predetermined current level when a current error voltage reaches a steady state.

Evidence Considered

Fukushi et al.	US 2006/0290333 A1	Dec. 28, 2006
Shimizu et al.	US 2007/0194759 A1	Aug. 23, 2007
Bazinet et al.	US 5,627,460	May 6, 1997
Barrow	US 2008/0231249 A1	Sep. 25, 2008
Portmann et al.	US 2005/0162931 A1	Jul. 28, 2005
De Lima Filho et al.	US 7,518,352 B2	Apr. 14, 2009
Eberlein	US 2006/0158158 A1	Jul. 20, 2006

Examiner's Rejections

(1) Claims 29-30, 33 and 36 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushi et al. ("Fukushi"), Bazinet et al. ("Bazinet"), and Shimizu et al. ("Shimizu"). Ans. 5-8.

(2) Claim 31 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushima, Bazinet, Shimizu, and Barrow. Ans. 8-9.

(3) Claim 32 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushima, Bazinet, Shimizu, and Portmann et al. (“Portmann”). Ans. 9.

(4) Claim 50 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushima, Bazinet, Shimizu, and De Lima Filho et al. (“De Lima Filho”). Ans. 9-10.

(5) Claims 38, 43, 45, and 51 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushima, Bazinet, Shimizu, and Eberlein. Ans. 10-16.

(6) Claim 42 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushima, Bazinet, Eberlein, Shimizu, and Portmann. Ans. 16-17.

(7) Claim 47 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Fukushima, Bazinet, Eberlein, Shimizu, and Barrow. Ans. 17.

Issue on Appeal

Based on Appellant’s arguments, the dispositive issue on appeal is whether the Examiner erred in rejecting claims 29-30, 33 and 36 under 35 U.S.C. §103(a) as being unpatentable over Fukushima, Bazinet, and Shimizu. In particular, the issue turns on whether the combination of Fukushima, Bazinet, and Shimizu discloses or suggests the following disputed limitations: (1) “generating a sense current ... without sensing a current

external to the integrated circuit,” (2) “maintaining an output voltage of the switching regulator at a predetermined voltage level when an output current of the switching regulator is less than a predetermined current level,” and (3) “maintaining the output current [of a switching regulator] at the predetermined current level when the output voltage is less than the predetermined voltage level,” as recited in independent claim 29. App. Br. 8-32; Reply Br. 5-10.

ANALYSIS

§103 Rejection of Claims 29-30, 33 and 36 over Fukushi, Bazinet, and Shimizu

The Examiner finds Fukushi discloses a method having all elements of Appellant’s independent claim 29, including: “generating a sense current ... without sensing a current external to the integrated circuit”, but without using: (1) a “bootstrap capacitor” and (2) “maintaining an output voltage of the switching regulator at a predetermined voltage level when an output current of the switching regulator is less than a predetermined current level,” and “maintaining the output current [of a switching regulator] at a predetermined current level when the output voltage is less than the predetermined voltage level.” Ans. 5-6 (citing Fukushi, ¶ [0057] and FIG. 1). The Examiner then finds Bazinet discloses “a bootstrap capacitor.” *Id.*, at 6 (citing Bazinet, col. 1, ll. 39-41; col. 2, ll. 5-8; and FIG. 1). Similarly, the Examiner finds Shimizu discloses a regulator, shown in FIG. 1 and FIG. 2, having a constant voltage (CV) mode, i.e., an output voltage at a predetermined level, when an output current is less than a certain value, and

a constant current (CC) mode, i.e., an output current at a predetermined level, when an output voltage is less than a certain value. *Id.*, at 6-7 (citing Shimizu, ¶¶ [0187], [0189], [0195], FIGS. 1, 2, and 4B).

Based on such factual findings, the Examiner concludes that it would have been obvious to (1) incorporate a “bootstrap capacitor” as disclosed by Bazinet into a switching regulator of Fukushi to generate the necessary voltage for driving the gate of the power switch during the on time, and (2) maintain an output voltage and an output current at a constant level, i.e., a predetermined level in the manner disclosed by Shimizu to charge a set of storage capacitors at the output. Ans. 6-7.

Appellant does not dispute the Examiner’s findings regarding Bazinet. Nor does Appellant argue against the Examiner’s articulated reasoning for incorporating Bazinet and Shimizu into Fukushi. Rather, Appellant contends that the Examiner has not made a *prima facie* case of obviousness because the combination of Fukushi, Bazinet and Shimizu does not disclose or suggest the disputed limitations of Appellant’s independent claim 29. App. Br. 8-32. In particular, Appellant argues that, contrary to the Examiner’s position, FIG. 1 of Fukushi does not generate “a sense current ... without sensing a current external to an integrated circuit.” *Id.*, at 9.

FIG. 1 of Fukushi is reproduced below:

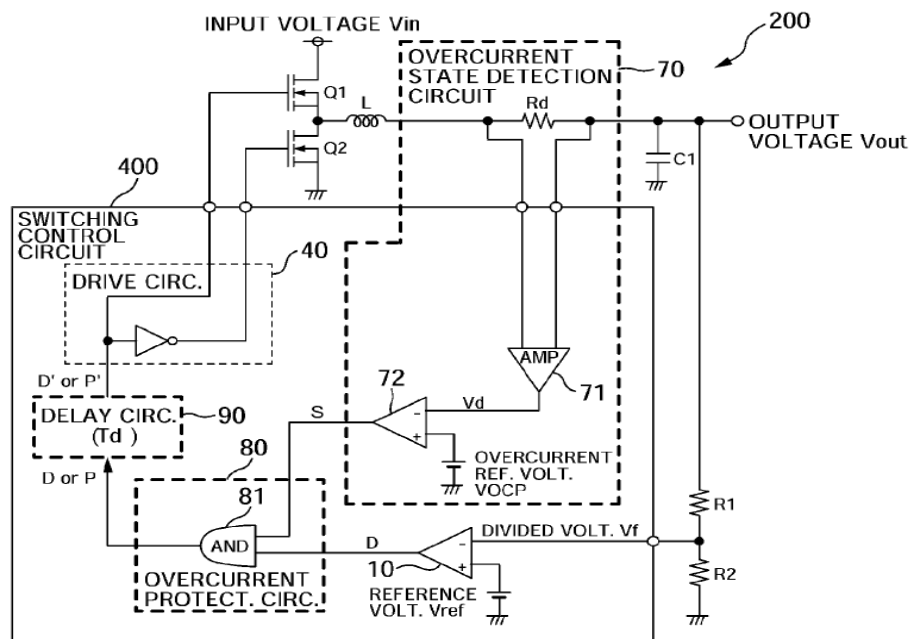


FIG. 1 of Fukushi shows a power converter 200 having external components connected to a switching control circuit 400 that is an integrated circuit (IC) provided with an overcurrent protection mechanism 70.

According to Appellant, the resistor R_d is located outside integrated circuit (IC) 400 and is used to sense the output current flowing externally to integrated circuit (IC) 400. *Id.*, at 10 (citing Fukushi, ¶ [0063]). Because the resistor R_d is used to sense the output current that is external to integrated circuit (IC) 400, Appellant argues that FIG. 1 of Fukushi does not teach “generating a sense current ... without sensing a current external to the integrated circuit” as recited in Appellant’s independent claim 29. *Id.*

Appellant further acknowledges ¶ [0057] of Fukushi describes that external components of FIG. 1, including resistor R_d , can be built into integrated circuit (IC) 400. Nevertheless, Appellant argues without any supporting evidence that “there is no apparent reason to modify [integrated]

circuit 400 to include resistance element Rd” because such “resistor Rd is on the node connecting coil L to capacitor C1 and is therefore part of the smoothing circuit that is difficult to integrate.” *Id.*, at 10-12.

Appellant’s arguments are misplaced. First, as shown in FIG. 1 of Fukushi, the resistor Rd is included as part of an overcurrent protection mechanism 70 that is provided within an integrated circuit (IC) 400. *See* Fukushi, ¶¶ [0057] and [0063] (emphasis added). As such, we agree with the Examiner’s finding that integrated circuit (IC) 400 of Fukushi generates “a sense current ... without sensing a current external to the integrated circuit.” Ans. 6. Moreover, we note that the term “without sensing a current external to the integrated circuit” is a negative limitation that, if accorded its broadest reasonable interpretation in light of Appellant’s Specification (*In re Morris*, 127 F.3d at 1055), would nevertheless be met by an output current generated from an integrated circuit (IC) 400, shown in FIG. 1 of Fukushi.

Second, even if the resistor Rd were located externally to integrated circuit (IC) 400, we still agree with the Examiner that paragraph [0057] of Fukushi describes that external components of FIG. 1, including resistor Rd, can be built into integrated circuit (IC) 400 as the resistor Rd is not part of the smoothing circuit of coil L and capacitance element C1, and therefore, can be integrated into integrated circuit (IC) 400. Ans. 18 (citing Fukushi, ¶ [0057] and FIG. 1). As such, the Examiner is not required to provide a rationale to integrate such a resistor Rd into integrated circuit (IC) 400 as disclosed by Fukushi, as asserted by Appellant. App. Br. 10-12; Reply Br. 5-7.

Appellant further argues that neither Fukushi, Bazinet, nor Shimizu discloses “maintaining an output voltage of the switching regulator at a predetermined voltage level when an output current of the switching regulator is less than a predetermined current level,” and “maintaining the output current at the predetermined current level when the output voltage is less than the predetermined voltage level,” as recited in independent claim 29. App. Br. 12-18; Reply Br. 7-10. In particular, Appellant acknowledges that Shimizu discloses a signal processing circuit 1061 of a charging apparatus, shown in FIG. 1 and FIG. 2, including a constant voltage signal generation circuit 103 to maintain a constant voltage (CV), and a constant current signal generation circuit 101 to maintain a constant current (CC). App. Br. 12-13, 16-17; Reply Br. (citing Shimizu, ¶¶ [0181], [0195]-[0196] and FIGS. 4A-4B). However, Appellant argues that Shimizu does not disclose the conditions upon which the constant voltage (CV) and the constant current (CC) are maintained, i.e., a constant voltage (CV) “when an output current is less than a predetermined current level” and a constant current (CC) “when an output voltage is less than a predetermined voltage level.” *Id.*, at 15, 17; Reply Br. 7-10. According to Appellant,

Shimizu explains that “the charge voltage V_c is compared with the predetermined voltage reference value V_{refv} ... so as to keep the charge voltage V_c to a constant level (constant voltage charge: CV)” (Shimizu ¶ [[0195]:13-17). The charge current is not, however, maintained at a constant current level when the charge voltage V_c is below V_{fu} . In fact, FIGS. 4A, 4B and 4C all show that current is changing (not maintained at a constant level) during the constant power charge (CP) mode during which the charge voltage V_c is less than V_{fu} Because the output current is not held constant when the charge voltage V_c is less than V_{fu} , Shimizu does not

teach maintaining an output current at a predetermined current level.

Reply Br. 9-10 (emphasis added).

We are not persuaded by Appellant's arguments. First, as correctly found by the Examiner, FIG. 4B of Shimizu shows the transition between a constant current (CC) mode and a constant voltage (CV) mode. Ans. 19 (citing Shimizu, ¶ [0196] and FIG. 4B). While the output current is changing (not maintained at a constant level) during a constant power (CP) mode, as noted by Appellant, FIG. 4B of Shimizu also shows that the output current is maintained at a constant level (I_{cc}') during a constant current (CC) mode even when the output voltage is less than the predetermined voltage level (V_{fu}), and likewise, the output voltage is maintained at a constant level (V_{fu}) during a constant voltage (CV) mode even when the current is below a predetermined level (I_{cc}'). Ans. 20-21; *also see* Shimizu, ¶¶ [0235]-[0236]. As such, we find the Examiner's factual findings regarding Shimizu are supported by a preponderance of evidence.

For the reasons set forth above, we find no reversible error in the Examiner's position and, as such, sustain the Examiner's obviousness rejection of independent claim 29 over Fukushi, Bazinet, and Shimizu.

With respect to dependent claims 30 and 36, Appellant presents no separate patentability arguments. For the same reasons discussed, we also sustain the Examiner's obviousness rejection of claims 30 and 36.

With respect to dependent claim 33, the Examiner finds Fukushi discloses "that the sense current increases during the on time (see FIG. 2), further comprising: determining a trip time (OCP point) at which the

increasing sense current equals the reference current (VOCP).” Ans. 8. Appellant argues that “VOCP” is an overcurrent reference voltage and is not Appellant’s claimed “reference current.” App. Br. 18. The Examiner responds that “VOCP *represents* a current level – the overcurrent set point of the converter” and, as such, can be reasonably interpreted as Appellant’s claimed “reference current” since the VOCP actually represents an amount of current. Ans. 21 (citing Fukushima, ¶[0063]).

We agree with the Examiner. While voltage and current are distinct, as noted by Appellant (Reply Br. 11), VOCP refers to the constant power (CP) mode in which both voltage and current are controlled to produce a constant power (CP) level, as shown in FIG. 4B of Fukushima. As such, we find the Examiner’s finding regarding Fukushima reasonable and supported by evidence.

With respect to claims 31, 32, 38, 42, 43, 45, 47, 50 and 51, Appellant presents no separate patentability arguments. Instead, Appellant reiterates the same arguments presented, i.e., none of the cited references, including Fukushima, Bazinet, Shimizu, De Lima Filho, Eberlein, Portmann, and Barrow, discloses or suggests: (1) “generating a sense current ... without sensing a current external to the integrated circuit,” (2) “a power converter generating an output voltage at a predetermined voltage level when an output current is less than a predetermined current level,” or (3) “a power converter generating an output current at a predetermined current level when an output voltage is less than a predetermined voltage level.” Claim 38. For the same reasons discussed, we also sustain the Examiner’s obviousness rejection of claims 31, 32, 38, 42, 43, 45, 47, 50 and 51.

CONCLUSION

On the record before us, we conclude that the Examiner has not erred in rejecting: (1) claims 29-30, 33 and 36 under 35 U.S.C. §103(a) as being unpatentable over Fukushi, Bazinet, and Shimizu; (2) claim under 35 U.S.C. § 103(a) as being unpatentable over Fukushi, Bazinet, Shimizu, and Barrow; (3) claim 32 under 35 U.S.C. § 103(a) as being unpatentable over Fukushi, Bazinet, Shimizu, and Portmann; (4) claim 50 under 35 U.S.C. § 103(a) as being unpatentable over Fukushi, Bazinet, Shimizu, and De Lima Filho; (5) claims 38, 43, 45, and 51 under 35 U.S.C. § 103(a) as being unpatentable over Fukushi, Bazinet, Shimizu, and Eberlein; (6) claim 42 under 35 U.S.C. § 103(a) as being unpatentable over Fukushi, Bazinet, Eberlein, Shimizu, and Portmann; and (7) claim 47 under 35 U.S.C. § 103(a) as being unpatentable over Fukushi, Bazinet, Eberlein, Shimizu, and Barrow.

DECISION

We AFFIRM the Examiner's final rejections of claims 29-49.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED